MOTOROLA

June 20, 2002

Michael J. Wilhelm
Designated Federal Officer, NCC
Federal Communications Commission
445 12th Street, S.W.
Room 3-C252
Washington, D.C. 20554

Re: WT Docket No. 02-55
WT Docket No. 99-168

Dear Mr. Wilhelm:

This letter is in response to your question expressed to me at the recent National Coordination Committee Steering Committee meeting on May 31, 2002 in Washington, DC. With respect to the public safety interference issues currently being considered by the Commission, you asked for a more detailed explanation of why better intermodulation (IM) interference protection in public safety radios would result in a greater level of power drain in those receivers.

Motorola addressed this issue in our Comments to the above WT Docket No. 02-55 proceeding:[1]

> *Public safety and private wireless receivers are designed to balance three inter-related user criteria - sensitivity, IM rejection, and electrical current drain. IM rejection performance can be improved by reducing the sensitivity of the radio, but since public safety and private wireless systems are designed as "noise-limited" systems, this change would reduce the effective coverage area for each base transmitter. This, in turn, would require PLMR licensees to construct additional base sites, creating additional cost burdens. IM rejection performance could be improved by increasing the electrical current used by several stages of the radio receiver. <u>However, this would significantly increase current drain in the radios and thereby reduce the battery life of the product.</u> Public safety radios are designed so that a single battery will last an entire shift. Reducing battery life would require first responders to carry an extra battery and would risk requiring battery replacement at critical times.*

Previously, the Telecommunications Industry Association (TIA) expressed a similar observation to the FCC with respect to improving intermodulation rejection performance in 700 MHz band receivers:[2]

> *Current state of the art for hand-held receiver design makes it extremely difficult to protect a receiver from strong inband, potential IM generating signals due to the high current drain required to improve IM performance.*

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1 *See, Comments of Motorola, Inc.,* WT Docket No. 02-55, submitted May 6, 2002, at 20 (*emphasis added*) (*hereinafter Motorola Comments*).

2 *See, Letter to Mr. Stan Wiggins, Senior Staff Attorney, from Bill Belt, Director, Telecommunications Industry Association,* WT Docket No. 99-168, submitted Nov. 6, 2001, at 6.

Motorola, Inc., Global Government Relations
1350 I Street, N.W., Suite 400, Washington, DC 20005 T: (202) 371-6900

The technical explanation of increased power drain is as follows:

Radio receivers must convert, or "mix", the desired frequency down to an Intermediate Frequency (IF) or baseband to do additional filtering and signal processing. The first stage of the radio receiver line up establishes the IM rejection capability of the receiver. This stage includes the front end Low Noise Amplifier (LNA); the Mixer that "mixes" the desired frequency down to the IF or baseband and the Injection VCO (Voltage Controlled Oscillator) for the Mixer that establishes the mixing frequency. In order to improve the IM rejection in the radio, design modifications must be made to the LNA, Mixer and Injection VCO. The IM phenomenon occurs when the LNA and Mixer begin to operate in a non-linear mode. The specification on these devices that determines the IM performance is called IIP3 (Third order Intercept Point). A radio manufacturer can improve the IIP3 in a radio design by increasing the current to the device. Because the sideband noise of the Injection VCO also contributes to the radio IM performance, it can similarly be improved by increasing the current of the VCO.

To make an appreciable change in the IM performance, for example 5dB, the IIP3 point for the LNA and Mixer must improve about 10 times (10dB). This requires a significant increase in current to these devices, by a magnitude of 4 to 5 times the existing power level. Because a public safety receiver is always on, the increased current drain will similarly have a significant impact on the hours of operation of the radio, decreasing the average battery life by two hours, out of a normal eight hours life. Because public safety users require a single radio battery to last for an entire shift, current battery technology does not allow radio manufacturers to overcome this significant reduction in battery life. First responders already carry a heavily loaded accessory belt. The battery is currently a large part of the weight of their public safety radio on that belt. They cannot be asked to carry a second battery all day, nor can they be placed at possible risk by requiring them to replace batteries at critical times.

Motorola also noted in its comments to WT Docket 02-55 that TIA has developed specifications that appropriately balance the cost and performance tradeoffs in receiver design.[3] As noted in those comments, Motorola supports the use of the TIA Class A specification for new public safety and private wireless radios.[4] The Class A specifications are targeted for state-of-the-art radio designs and specify -75dB (mobiles) and -70dB (portable) for intermodulation rejection.[5] Improved filtering within a handheld receiver beyond this level is not currently viable as it increases the current drain and size of the radio and drastically reduces sensitivity to the desired signal. Receiver intermodulation rejection is only one of the relevant factors in resolving interference. Solutions for resolving the existing interference to 800 MHz public safety systems must consider the entire spectrum environment.

We hope that this information assists the Commission. Please let us know if we can be of further help.

Sincerely,

/S/ Al Ittner
Al Ittner
Manager, Spectrum and Regulatory Strategy
Motorola

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3 *Motorola Comments* at 21.

4 *Id.*

5 These specifications are defined in ANSI/TIA/EIA-102.CAAB.